Answer only 4 questions

1) Discuss briefly: a) Economic dynamics & equation showing the rate of growth of national income
2) Discuss briefly a) Uniform growth

   b) the economic dynamics under the assumption of unlimited labor supply
3) Discuss Alternatives of the real wage rates determination as mean to increase investment resources
4) a) Discuss briefly techniques of production

   b) Types of technical progress
5) Discuss; a) The impact of increasing k-intensity on the rate of growth, rate of employment and productivity of labor , b) Estimating the economic efficiency for new investment where there are different alternatives of capital intensity
6) Determination of economic dynamics in the short run and in the long run
7) Balanced versus unbalanced growth
8) Methods of constructing national economic planning

Economic Dynamics

Definitions and assumptions

- We define national income in a given year as the value of output of goods and services in a year after cutting the value of raw materials and semi-manufactures used in the production process (including imported raw materials).
- The components of national income according to its final use are as following;

National income = Productive investment
(+) Increase in inventories
(+) Non-productive investment
(+) Collective consumption
(+) Individual consumption
(+) Imports
(-) Exports

- The sum of productive investment and increase in inventories is called productive accumulation.

Basic equations

- In this section we will determine the relationship between the growth of national income and its components.
- Let us denote the national income in a given year by Y , productive investment by I , the increases in inventories by S , and the consumption in the broad sense by C .

Thus we can say .. $Y = I + S + C$ (1)

- Where I + S is the productive accumulation .

- Let us assume that (ΔY) is the difference between the national income of the next and the given year, which is due to the productive effect of investment I .

$$\Delta Y = \frac{1}{m} I$$ where, m is the capital output ratio .

- There are, however, other factors affect the increment of national income.

First, the depreciation of capital equipment ..

- The national income declines at the beginning of the next year considered by the amount (a Y) , where a is a co-efficient called the parameter of depreciation .

Second, An increase in national income due to improvement in the utilization of inputs by the amount (u Y), u being the co-efficient which represent the effect of such improvements .

- Thus; $$\Delta Y = \frac{1}{m} I - a Y + u Y \qquad (2)$$

- Let us divide both sides of equation (2) by Y :

$$\frac{\Delta Y}{Y} = \frac{1}{m} . \frac{I}{Y} - a + u$$

- If we denote (r) the rate of growth of national income we obtain :

$$r = \frac{1}{m} . i - a + u \qquad (3)$$

Where , $\frac{I}{Y}$ = (i) (investment ratio)

- On the assumption of constant m , a and u , if investment is increased at the same rate as the national income , a constant rate of growth of national income exists .

- If (I) expands more rapidly than (Y) , then according to the formula (3) this raise the rate of growth of national income r to be accelerated growth.

- **We shall show the relationship between the increment in the national income and the increase in inventories .**
- We may assume that the volume of inventories rise proportionately to the national income , $S = \theta \Delta Y$ (4)
- Where θ is the ratio of the volume of inventories and the national income (also called the average period of turnover of inventories) .

Equation (3) may be re-written as follows :

$$\frac{I}{Y} = (r + a - u)\, m$$

- and equation (4) in the form , $\frac{S}{Y} = \theta \frac{\Delta Y}{Y} = \theta\, r$

By adding these equations we obtain :

$$\frac{I+S}{Y} = (m+\theta)\, r + (a-u)\, m$$

- and thus , $$\boxed{r = \frac{1}{m+\theta} \cdot \frac{I+S}{Y} - \frac{m}{m+\theta}(a-u)} \qquad (5)$$
- (I + S) is the productive accumulation . We denote its relative share in the national income (i) where, $i = \frac{I+S}{Y} = \frac{I}{Y} + \frac{S}{Y}$
- Let us moreover, denote $m + \theta$ by K . We shall call K the capital output ratio for total capital, since it indicates the amount of fixed capital and inventories which is required in order to produce a unit increment of the national income.
  - By introducing these symbols in equation (5) we obtain ,

$$r = i \frac{1}{K} - \frac{m}{K}(a - u)$$

- It will be seen from this equation that, if the parameters K , m , a and u .remain constant then a constant rate of growth r is sustained .
- If, however, the growth of the national income is accelerated (r rises), the relative share of productive accumulation in national income i must increase.

Uniform growth

The process of economic growth which is characterized by the following features:

1- The rate of growth of the national income (r) is constant .

2- The labor productivity (MP_L) in the new plant increases due to technical progress at a constant rate (α).

In other words, the productivity of labor in the establishment brought into operation in a given year is higher than that the preceding year of production by the proportion ($1 + \alpha$).

3- The parameters (m , K , a and u) and α are constant .

4- Full employment, the rate of growth of employment(ε) must be equal to the rate of growth of labor force (β)

And , the rate of growth of national income r is determined jointly by the α (which depends upon the technical progress) and β (which depends upon the rate of natural growth of the labor force) .

$$(1+r) = (1+\alpha) + (1+\beta)$$

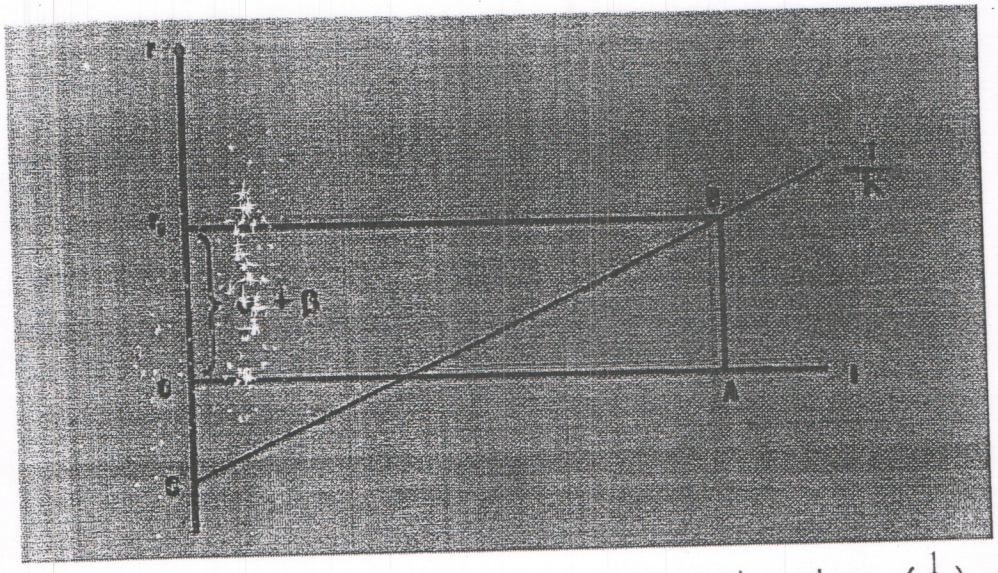
$$1 + r = 1 + \alpha + \beta + \alpha\beta$$

$$r = \alpha + \beta$$

- On the other hand , the rate of growth r determines (given parameters m , K , u and a) the constant relative share of productive accumulation i in the national income .

$$r = i\frac{1}{K} - \frac{m}{K}(a-u)$$

- This determination of (i) in equation above can be represented by the next figure ..

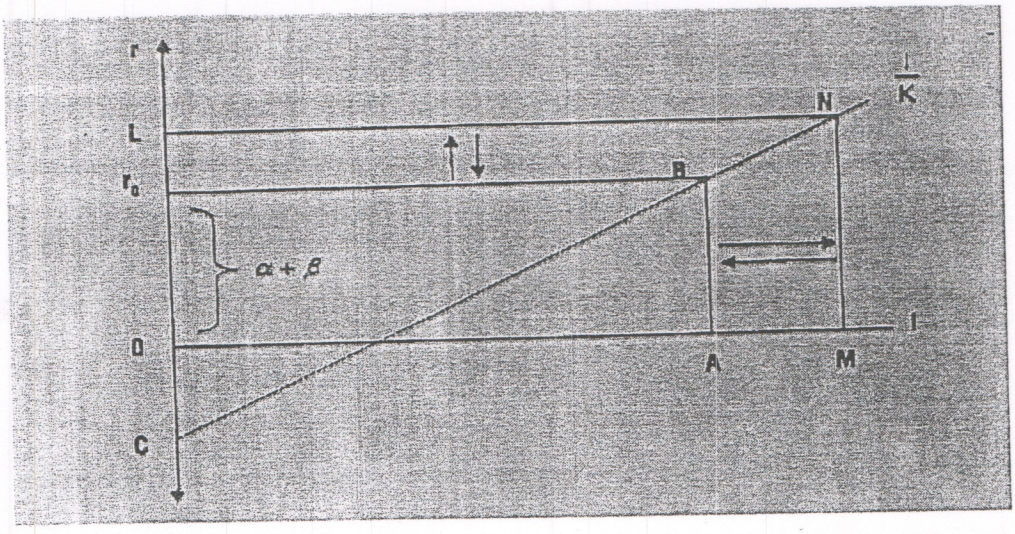


- The straight line (CB) representing the slope ($\frac{1}{K}$) and intersects the vertical axis at the point (C).
- The rate of productive accumulation (i) which corresponds to the rate of growth $r = \alpha + \beta$ is i = OA .
- As long as our two conditions: constant m , K , a and u & with full employment, the acceleration of growth economic (r) above the determined rate , is impossible , because of the barrier of the shortage of manpower .
- Therefore , there would be no sense in raising the relative share of productive accumulation in the national income (i) in order to accelerate (r) , because ; it would only lead to the creation of idle productive capacities .

Economic dynamics under the assumption of unlimited labor supply

- We shall now consider a situation characterized by the existence of a reserve of manpower , so , drawing on such a reserve makes it possible to raise the rate of increase in employment and consequently the rate of growth of the national income (r) (remember that $r = \alpha + \beta$) . Where β = the rate of growth of employment.

- We start by increasing the relative share of productive accumulation in the national income (i) . we can draw the following figure ...

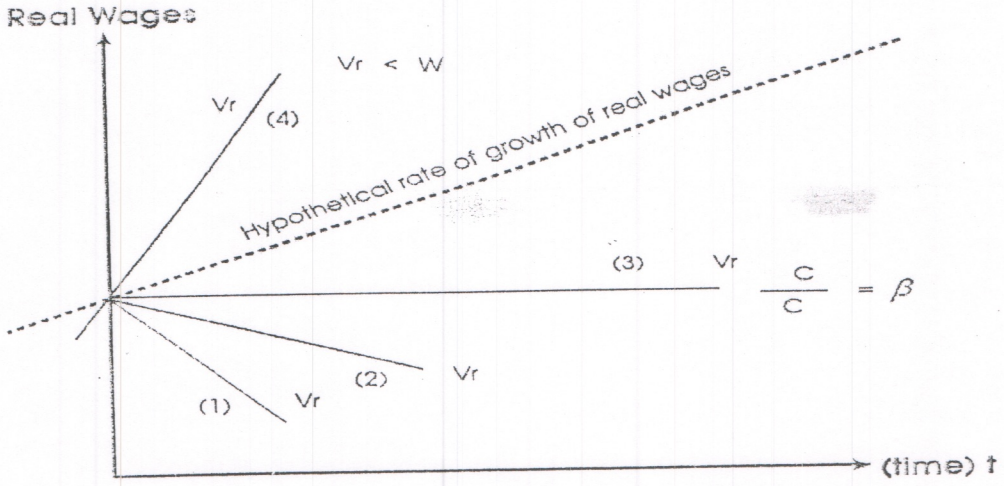


- Since (i) (the rate of productive accumulation) which corresponds to (r) (the rate of economic growth) .
- So that ($r_0 = \alpha + \beta$).
- Then by raising (β) (the rate of growth of employment) , (r) would increase to the level (OL) , and (i) expands from (OA) to (OM) .
- But the increase in (i) (the relative share of productive accumulation) consequently results , an equivalent decline in the relative share of consumption , since ($C/Y = 1 - i$) .
- This deterioration in the consumption level in the short run is the cost paid for increasing (r), and this also means that this sacrifice of consumption in the long-run will bring higher rate of growth of the national income.

Alternatives of real wage rates determination as mean to increase investment resources

- If we assume that in order to increase the relative share of investment to national income, the relative share of consumption to the national income must be decreased.
- The following table shows the alternatives of a temporary decrease in the real wages and its impacts on investment resources.

Alternative	Impact on consumption	Impact on investment and real wages
First	Decreasing total consumption fund	Large increase in investment and considerable decrease in real wages
Second	Fixed total consumption fund through a certain period of time	Allocation of the total increase in national income to investment fund and relative small decrease in average real wages
Third	Increasing consumption at the same rate of increasing employment	Partial allocation of the increase in national income to consumption fund with a constant average real wages
Forth	Increasing the level of consumption at a rate higher than the rate of employment (provided that, the productivity must increase at a rate higher than the rate of increase of real wages)	Increasing investment fund at the same time increasing the average real wages



Where; Vr = rate of growth of average real wages .

W = rate of growth of average productivity of labor .

ΔC = annual increase of consumption, β = rate of growth of employment

First alternative

- In the normal situation, there is no need to increase the rate of investment through an absolute decrease in the fund of current consumption.
- However, this option has been adopted in the early stages of industrial development in China and the previous Soviet Union , where they decreased the total volume of consumption in order to increase the rate of investment to build the heavy industry .
- This alternative is very difficult to be applied in many underdeveloped countries.
- As labor productivity in these countries depends upon the level of consumption in these countries; The higher the level of consumption the greater will be the level of labor productivity .
- Nevertheless, this alternative which decreases the level of real wages could accelerate the investment fund and thus avoid the deterioration of labor productivity.

Second alternative

- In this pattern, it is possible to increase the relative share of investment in national income at a reasonable rate without a decreasing the total consumption through a fixed total consumption fund and allocating all the increase in national income to productive investment .
- Here, the real wages will decrease but not as previous alternative.

Third alternative

- We assume in the third alternative that consumption is growing at the same rate of an increase in employment to avoid the decrease of real wages and therefore the average real wages will be constant. $\frac{\Delta C}{C} = \beta$

Fourth alternative

- In this option, it is possible to increase total consumption , investment, and real wages under the condition that productivity of labor must increase at a rate more than the rate of increase of real wages

Choice of Production Technique: Capital intensive or labor intensive

- The problem of choice of technique will arise when the same product could be produced using different proportions of input mix . [100 units of product A can be produced using 5 machines and only one worker (capital intensive) or 1 machine and 20 workers (labor intensive technique) .
- Using capital intensive technique results high rates of economic surplus and using labor intensive technique generates more income and thus the relative share of wages to national income would be relatively high but with less economic surplus compared to capital intensive technique.

Basic assumptions and the choice dispute

To illustrate the dimensions of choice issue, we should assume the following:

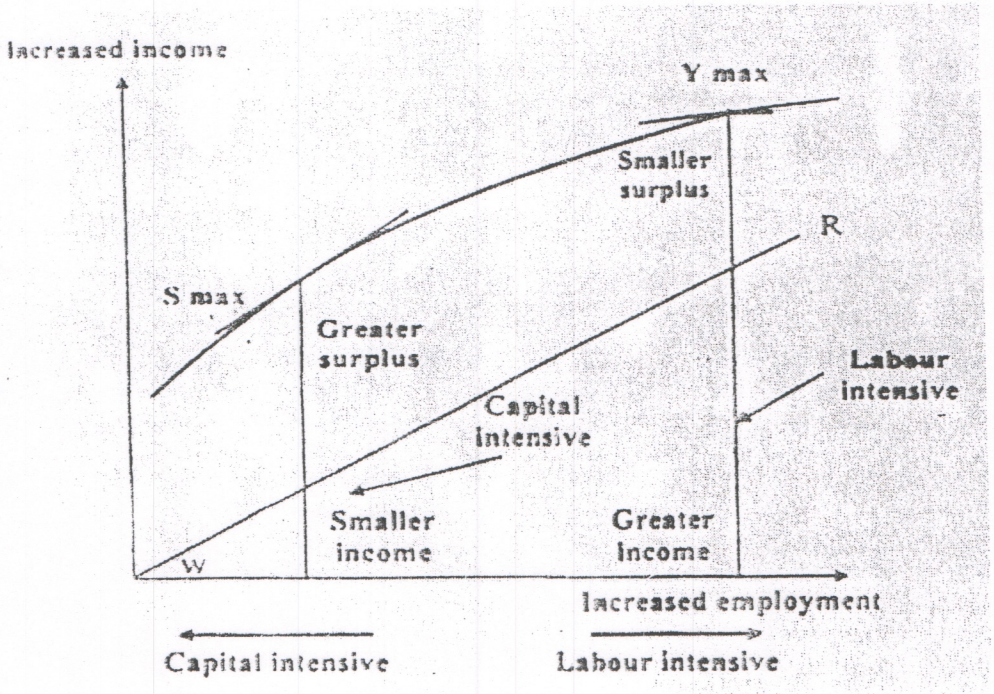
1- Certain volume of investment or initial capital outlays .

2- Constant average real wages .

3- Increasing employment following by increasing total wages .

4- No technical progress or it is constant in the short run .

Next figure shows the difference between capital intensive and labor intensive techniques as far as income surplus are concerned:



The optimum technique for developing countries

- Developing and developed countries tend to prefer labor-intensive technique to absorb the surplus of unemployed labor.
- Capital-intensive technique requires high level of saving for initial investment whereas developing countries are suffering from low saving rates and scarcity of capital resources to generate more income and then increasing wages.
- However , Sen & Dobb argued that the choice of capital intensive technique provides relatively greater economic surplus and accelerate the rate of growth of national income in the long run , assuming that the economic surplus is allocated entirely for investment purposes.
- While labor-intensive technique produces more income ad absorb greater portion from the unemployment reservoir but at the same time wages will increase in proportion to employment and consumption. That is why economic surplus will be limited.

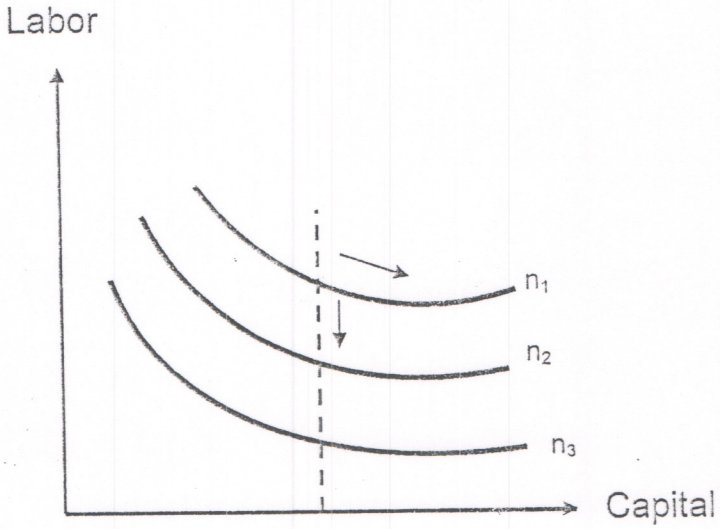
Technical or technological progress

The concept of technical progress:

- We mean by technical progress realization of an increase in the volume of production without a simultaneous increase in the input of the means of production or a realization of the same level the volume of production using less input due to the effect of the productivity growth.

Technical progress and production function

- Every production function represents a certain technical methods and life span of initial investment.



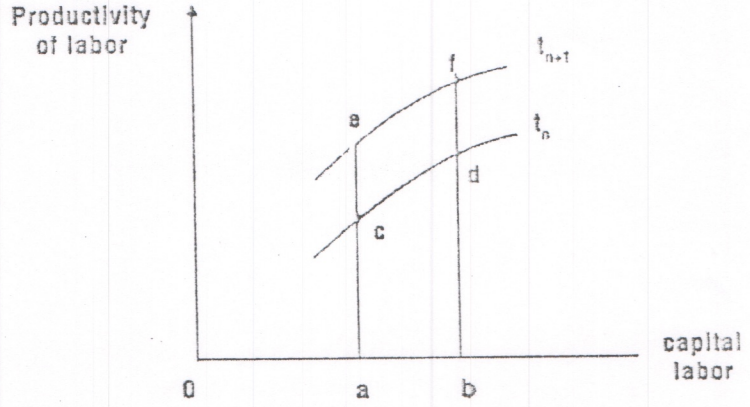
- Every production curve n_1 , n_2 and n_3 refers to certain level of technical progress.
- At the same time every point on the same curve refers to the same level of production according to certain level of technical progress using different means of production mix .
- Moving to the left indicates that we use labor-intensive technique while moving to the right denotes the application of capital intensive technique.
- The transfer from n_1 to n_2 means choosing more advanced technique and modern methods of production.

Types of technical progress

There are three types of the technical progress as following:

1- Neutral technical progress.
2- Encouraging technical progress or capital saving technology.
3- Discouraging technical progress or capital absorbing technology.

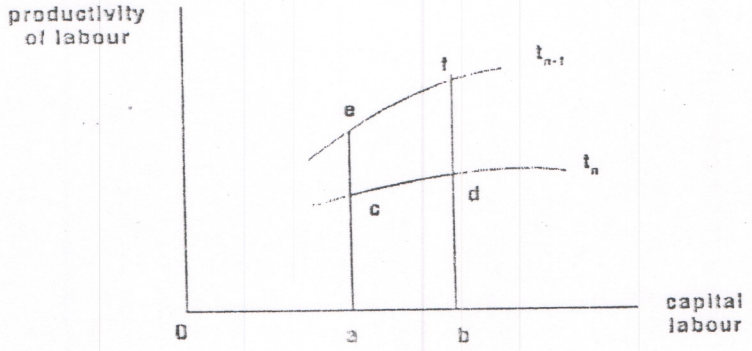
1- Neutral Technical Progress



- Figure above indicates that, the rate of increase of labor productivity is the same in the labor intensive and capital intensive techniques. When, $\frac{ec}{ca} = \frac{fd}{db}$.

2- Encouraging technical progress

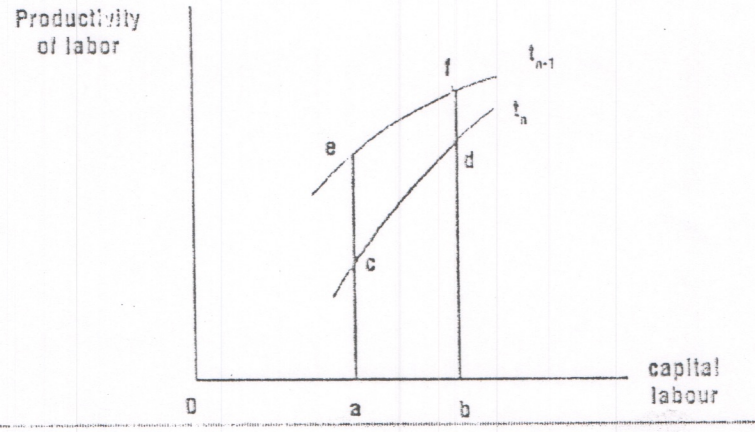
- In the encouraging capital intensity of technical progress , the labor productivity will increase at a higher rate than the capital labor ratio . Consequently, capital output ratio would tend to decrease as it is illustrated in next figure .



Where, $\frac{ec}{ca} < \frac{fd}{db}$

Discouraging technical progress

- In this case, capital labor ratio is increasing at a rate higher than the rate of increase of labor productivity. That is why the capital output ratio would increase as shown in next figure.



Where,

$\frac{ec}{ca} > \frac{fd}{db}$

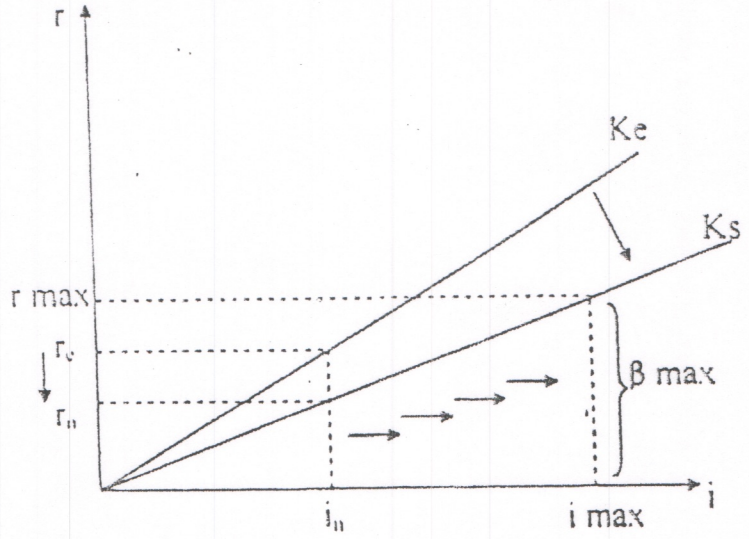
The impact of increasing capital intensity on rate of growth, rate of employment, and the productivity of labor

As you might know the investment function includes independent and dependent factors and can be expressed as follow:

$$I = a + by$$

- Where a stands for the part of investment which is determined outside the model. The source of this part is the economic surplus generated in the traditional sections as agriculture and extracting.
- And by stands for the part of investment which is determined inside the model from the capital intensive industries.

From next figure :



- we notice that the changing from labor intensive technique with lower capital output ratio **Ke** to capital intensive technique with capital output ratio **Ks** which is higher than that of **Ke** ,

The following results will occur :

1- The rate of growth of national income will decrease from r_e to r_n and this will happen if we fix the rate of investment at its previous level.

- And this situation will hold true for a certain period until the dependent investment " economic surplus " grows and ensuring the rate of growth of national income set-up .
- As a matter of fact we take into consideration that $r = \alpha + \beta$

2- The increases of capital intensity affect the average productivity of labor and its rate of increase.

- The shift to higher capital intensity tends to increase the average productivity of labor i.e. it increase the average number of the final product produced by a worker or a unit of labor .
- At the beginning of the transitional period from labour intensive to capital intensive technique , and as a result of higher intensity of capital , the productivity of labor increase at a higher rate and afterwards the rate of increase of the productivity of labor starts to diminish gradually to zero.
- **In order to illustrate this process we would assume the following :**

1- The average productivity of labor who work on equipments characterized by capital output ratio Ke (low capital output ratio) will be P_0 .

2- If the expansion in the factory depends on the same type of equipments [at Ke] , the average productivity of labor would continue at the same level P_0 and consequently the rate of growth of labor productivity will be $\Delta P/P = 0$.

3- But if there are expansion and changes in the factory using more advanced techniques , the capital output ratio in the factory concerned will be Ks , where Ks > Ke which will increase the economic surplus , accompanied by higher average productivity of labor P_1 .

4- The shift from Ke to Ks would follow through number of successive years

In order to explain the gradual change in average productivity of labor and its rate of increase , we may use the following table :

	(1)	(2)		(4)	(5)	(6)
	$t_1 - t_4$	t_5	t_6	t_7	T_8	T_9
	P_1	$\Delta P + P_5$	P_5	P_5	P_5	P_5
	P_2	P_2	$\Delta P + P_6$	P_6	P_6	P_6
	P_3	P_3	P_3	$\Delta P + P_7$	P_7	P_7
	P_4	P_4	P_4	P_4	$\Delta P + P_8$	P_8
Average productivity	$P_0 < P_1 < P_2 < P_3 < P_4 < P_5$					
Rate of increase of productivity of labor	$\frac{0}{P_0} = 0$	$\frac{\Delta P}{P_1}$	$\frac{\Delta P}{P_2}$	$\frac{\Delta P}{P_3}$	$\frac{\Delta P}{P_4}$	$\frac{\Delta P}{P_5}$

The period of transition from Ke to Ks

Ke ⟶ Ks

Estimating the economic efficiency for new investment where there are different alternative of capital intensity .

To choose between different alternative **we assume that :**

- I_1 → the value of investment in the first alternative .
- I_2 → the value of investment in the second alternative .
- O_1 → average current cost in the first alternative .
- O_2 → average current cost in the second alternative .
- We may assume also that, the volume of production is the same in the two alternatives.
- Given that, $I_1 > I_2$, $O_1 < O_2$ .. Note , the increase investment in the first alternative leads to a reduction of annual current cost due to technical progress .
- We can now derive a criteria of economic efficiency for investment which express the reduction of annual current cost realized by increasing the amount of investment in the first alternative : $E = \frac{\Delta O}{\Delta I}$

- **We can also** , deduct a criteria for the recovery period . [The recovery of increased amount of investment in the first alternative by saving of annual current cost] .
- The criteria for the recovery period is the reciprocal of the criteria of economic efficiency for investment .

$$R = \frac{1}{E} = \frac{\Delta I}{\Delta O}$$

- Where, **R** denotes the period of recovery .

Ex.

Alternative	The amount of investment in pounds	Current cost in pounds
1	800 000	170 000
2	600 000	200 000

$$E = \frac{\Delta O}{\Delta I} = \frac{200000 - 170000}{800000 - 600000} = 15\ \%$$

And , $$R = \frac{\Delta I}{\Delta O} = \frac{1}{0.15} = 6.7 \text{ years}.$$

- The higher the value of " E " , the lower will be the criteria " R " and the greater must be the economic efficiency .

Determination of Economic Dynamics in the Short-run and in the Long-run

- Economic growth in the long run depends on national and economic resources and endowments.
- These resources include capital, land, labor, organization and TP (Technical Progress).
- Thus, the level of production can be produced due to the available mix of production factors and constraints or/and conditions of production.
- In the short-run, the productive capital is constant and any increasing in the level of production will be due to an increase in the productive capacity.

The concept of productive capacity (utilized capacity)

- It's the maximum level of production within a certain limit of employment.
- This full utilized capacity is obtained only when the equipments are operated 24 hours and 365 days with full employment.
- The productive capacity is roughly fixed in the short run.
- It may be expanded in the long run if the supply of labor and factors of production are capable to increase.

How ca we measure the productive capacity?

1- By estimating the inputs of production function; it can be achieved at the maximum level depending on the volume of inputs to the production function.

- This indicates that we can judge a production at full capacity and below this level.

2- Capital output ratios reflect the relation between invested capital and the volume of output. In the short run, the ratio is constant since production technique is supposed to be fixed. Any changes in capital output ratio will be due to the degree of capacity utilization.

- Assuming $\hat{K}$ denotes proposed capital output ratio which is the relation between the capacity investment $\hat{I}$ and output Q.

$$\hat{K} = \frac{\hat{I}}{Q}$$

- At the same time if there is actual capital output ratio reflects the relation between the actual invested capacity I and the actual output Y where $K = \frac{I}{Y}$.
- Thus the degree of utilization of the invested capital or the measurement capacity will be:

$$\text{Capital utilization} = \frac{\hat{K}}{K}$$

3- <u>The rate of total utilization:</u> This concept assumed that the main input to the production process is labor force and as also the utilization of total capital depends on labor force.

- It's assumed also that the shift is 8 hours and the invested capital is 24 hours per day.
- To obtain the number of the operation for invested capital, we need to multiply the data about the number of shifts and working hours for each worker.
- It's also assumed to have a base year and also index number for capacity utilization to follow fluctuations of this criterion.
- Assuming that demand side in normal thus increasing shifts will improve the rate of employment due to absorbing more labor.
- It's also definitely will maximize the output and economic surplus via decreasing the capital cost per unit of the output.
- Full shifts or (multiple shifts) can be calculated as follows:

$$Sh = \frac{E_1 + E_2 + E_3}{E_1}$$